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ABSTRACT

The development of a curriculum review mechanism, the Curriculum Interaction Model (CIM) and how it is being used for academic planning and management purposes at two distinctly different institutions, the State University College of New York at Buffalo and Barnard College of Columbia University, is described. The CIM is a quantitative academic management tool designed to assist academic officers with curriculum evaluation and resource allocation. The CIM consists of two reports, a Department Contribution Report and a Major Contribution Report. Information contained in the two reports is summarized and displayed through an interaction matrix, an interaction graph, and an interaction trend analysis, examples of which are provided. The appendix contains the Contributions Report of the Biology Department at Buffalo State. (SPG)

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THE APPLICATION OF AN ANALYTIC MODEL FOR CURRICULUM REVIEW

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THE NEED FOR STUDY

The objective of this paper is to describe the development of a curriculum review mechanism, the Curriculum Interaction Model (CIM), and how it is being used for academic planning and management purposes at two distinctly different collegiate institutions. The Curriculum Interaction Model is a quantitative academic management tool designed to assist academic officers with curriculum evaluation and resource allocation.

The declining pool of high school graduates and economic inflation are causing colleges and universities to seriously consider the need for better organizational planning and management. The selection of effective management strategems becomes important in a time when most colleges and universities are facing the problem of how to manage their academic programs with diminishing financial resources. Unfortunately, most strategems currently being used tend to regard the problem of "better resource management" as if it were only an economic problem which would best be solved by exercising greater fiscal responsibility through cost accounting procedures.

It was hypothesized, as a way of dealing with this problem, that the constant for analyzing an academic organization must be the curriculum. The curriculum is the core of the institution. This premise was presented since all material and personnel resources in an academic organization directly or indirectly support the academic programs of the curriculum. Given this hypothesis, it follows that the significances of all institutional

planning and management efforts are derived from the manner in which they affect and relate to the curriculum. Therefore, a curriculum review mechanism, Curriculum Interaction Model, was designed to address the critical problems of curricular analysis and resource allocation.

The Model has been integrated into the academic planning process at two colleges, The State University College at Buffalo and Barnard College of Columbia University. The two institutions are distinctly different in organizational structure and academic mission.

Buffalo State is the largest of the SUNY colleges and offers bachelors and masters degrees in the arts and sciences, education and applied technologies. The College enrolls approximately 10,000 students. Over a three-year period the SUNY system experienced large budget cuts and the College was faced with the challenge of managing high demand academic programs with diminishing financial resources. Problems of resource analysis and resource allocation presented serious challenges to the achievement of the College's academic mission within SUNY.

In like manner, Barnard College of Columbia University was faced with problems of fiscal stringency and resource analysis. Barnard is an independent liberal arts college for women with its own curriculum, faculty, admission standards, and graduation requirements. The impact of inflation on fixed operating costs motivated the College to take a comprehensive look at the total operational structure. As in the case of Buffalo State, Barnard began to evaluate its academic structure for purposes of reallocating resources. At Buffalo it was known that the State would not provide the College with additional funds to staff growing academic programs. Consequently, the College was faced with the need to make internal reallocations of support dollars and faculty positions from

low demand to high demand programs.

Since Barnard is an independent and privately endowed college, the need to analyze its resources was even more immediate. The yearly rate of inflation and income from student fees impacted on the College's ability to maintain its physical plant, support services, and provide an educational program congruent with its mission. The costs associated with the use of University facilities was also increasing. Also, there was a high interdependence between the curriculum of Barnard College and the curriculum of Columbia College (the men's college of Columbia University). Students were free to cross register between the two Colleges. For purposes of planning, Barnard needed to know what proportion of Columbia College students were taking Barnard courses and what proportion of Barnard College students were taking Columbia courses.

BACKGROUND TO MODEL DEVELOPMENT

Some of the most important questions an academic department asks when it begins the process of self evaluation and resource analysis have to do with determining how course enrollments affect the department's curriculum. Questions such as: What is the class mix of students enrolling in departmental courses? What academic programs are the department's courses serving? What changes in course patterns take place in the transition from lower to upper division? If a program is expanding (or contracting), what are the course load implications for the discipline? What kinds of change do programs exhibit over time in terms of student size and course consumption patterns? Answers to such questions have a direct impact on defining a department's contribution to the total curriculum.

In general, department heads at Buffalo State and Barnard College did not have much feel for the contribution their departments made to other departments, either in terms of types of majors served or specific courses offered. Not much was known about the course consumption patterns of various majors or about the extent to which their needs were being met by departments. There was, in short, a need to raise the general level of awareness with respect to both departmental course contribution and program consumption patterns.

The Curriculum Interaction Model was designed to assist academic officers answer these questions. The Model is a computerized adaption of the National Center for Higher Education Management Systems course load matrix program and was specifically designed to reflect the particular college's departmental and program structure. The Model focuses on the presence or absence of course interaction between and among academic departments and student programs. The interactions may be seen in terms of "supply and demand."

The data required to construct the Interaction Model is taken from student registration records. For an academic year report, one data record is required for each student registered in each class in each semester. The record contained the following pieces of information:

student identification number
student semester or term
student major or program
course discipline identification
course level
number of credit hours or units

THE MODEL AND REPORTING FORMATS

The Curriculum Interaction Model consists of two reports, a Departmental Contribution Report and a Major Consumption Report. Information contained in the two reports is summarized and displayed through an Interaction Matrix, an Interaction Graph, and an Interaction Trend Analysis.

Department Contribution Report

The primary academic management unit is the "department." Departments provide services through their professional staff. In systems language, services (faculty teaching courses) flow from departments to academic majors. In other words, departments contribute courses to majors, thus the Department Contribution Report. The Report indicates the flow of credit hours or units from the department to academic majors. It focuses on individual departments and shows which majors they serve. The report illustrates the number and percentage of student units "contributed" by each department to each major. For example, the English department may be shown to provide courses not only to English majors but also to history majors, mathematics majors, interdisciplinary majors, and undeclared students (among others). These course contributions by the English department may be summarized in terms of the total amount of coursework contributed to each type of student major (for example, 260 credit hours to English majors, 120 credit hours to history majors, etc.).

Major Consumption Report

Although departments manage academic programs, departments do not contribute all of the coursework to their majors. An academic major is made up of several courses contributed by several departments. Therefore,

student majors consume resources (courses) from different departments across the campus, thus the Major Consumption Report. This report indicates, for each major, the departments in which those student majors take coursework. It also contains enrollment figures for each program and student level. The report indicates the total units taken by all students in each major from each department. This might show, for example, that physics majors take coursework in physics, mathematics, English, sociology and a variety of other disciplines. Here again, these data may be shown in terms of total student credit hours and/or average student credit hours.

The Interaction Matrix

The Interaction Matrix displays the "mix" of student credit hours or units that exist between departmental course offerings and the demands from academic programs. The magnitude of this interaction is shown through the percentage of credit hours or units generated by students enrolling in courses at the lower, upper, and graduate levels. Departments and majors are listed according to the college's particular academic division structure. The basic terms used in the Interaction Matrix are:

--Curriculum Interaction - the "mix" of student credit hours that exists between departmental course offerings and the demands from academic programs.

--Interaction Magnitude - the annualized percentage of credit hours generated by students enrolling in departmentally contributed courses.

--Students Enrolling - students enrolling in departmental courses are identified by specific major programs.

--Contributing Departments - an academic unit which offers course credit hours in a specific academic discipline.

--Consuming Major - an academic program which consumes course credit hours contributed by various academic departments throughout the college.

Figure 1 shows a portion of the Interaction Matrix for the Design Department of the Fine Arts Faculty at Buffalo State. The first aggregate in the Matrix under the heading "programs contributed to" displays the percentages of curriculum interaction by course level that exists between the Design Department and other programs in the Fine Arts Faculty to which the Design Department contributes. These other programs are identified by HEGIS (Higher Education General Information Survey) code and name. The Design Department also interacts with other programs outside its own Faculty. These various other programs have again been aggregated according to the academic faculty in which they occur and then identified by HEGIS number and name. Thus the group beginning with Anthropology-B.A. identifies the programs in the Humanities and Social Sciences Faculty with which the Design Department interacts.

A part of the Interaction Matrix for the B.S. in Design program is shown in Figure 2. As is the case in the contribution format, the consumption format displays the various departments from which the Design Bachelor of Science program consumes resources. These departments are aggregated according to the faculty unit of which they are members.

In both matrix reports the credit hour variables by course level are clearly organized and it is possible for department heads and deans to get some feel for the nature of the curriculum interaction between a contributing department and a consuming academic major. These academic managers can begin to track the flow of their curricular efforts and the resources that accompany these efforts. This kind of examination can lead, for example, to observations that majors of one type draw heavily upon a given department's courses while other majors consume that same department's courses only to a minimal extent. The appropriateness or desirability of such patterns can then provide the basis for discussions concerning future

Figure 1

DEPARTMENT INTERACTION MATRIX EXAMPLE

Contributive Display
Academic Department and Interdisciplinary Programs
The Arts

Programs Contributed To		Contributing Department - Design (1009) Lower Div	Upper Div	Grad Div	Total	Headcount	Credit Hours
1001	Art-BA	4.90	1.70		6.60	00171	654.00
0831	Art Education-BS	18.70	7.40	2.00	28.10	00671	2794.00
1003	Art History-BA	.10			0.10	00013	15.00
1009	Design-BS	11.20	7.90		19.10	00222	1904.00
1005	Music-BA	.10			0.10	00019	6.00
1011	Photography-BFA				0.00	00002	3.00
1096	Sculpture-BFA		.10		0.10	00001	12.00
1098	Speech-BA				0.00	00017	6.00
1095	Theater-BA				0.00	00018	6.00
1007	The Arts-BA	.10			0.10	00004	9.00
1097	Undeclared-BFA	1.50	.30		1.80	00073	174.00
**********	Faculty Totals	36.60**	17.40**	2.00**	56.00**		5583.00**
2202	Anthropology-BA	.10			0.10	00029	12.00
0605	Communica Media	.40	.20		0.60	00183	65.00
2209	Criminal Jus-BA	1.80	.30		2.10	00554	204.00
2204	Economics-BA	.40			0.40	00113	45.00
1501	English-BA	.20		.10	0.30	00135	27.00
0882	English Seced-BS	.20		.10	0.30	00206	30.00
1102	French-BA				0.00	00008	3.00
0883	French Seced-BS	.10			0.10	00025	12.00
2206	Geography-BA	.10			0.10	00016	12.00
1103	German-BA				0.00	00007	3.00
2205	History-BA	.20			0.20	00122	21.00
4903	Humanities-BA	.20			0.20	00015	18.00
1799	Mathematics-BA	.10			0.10	00039	9.00
1701	Mathematics-BS				0.00	00011	3.00
0833	Math Sec Ed-BS	.40			0.40	00124	39.00
1509	Philosophy-BA				0.00	00020	3.00
2207	Political Sci-BA				0.00	00093	2.00
0881	Sec Soc St-BS	.10			0.10	00168	9.00
4999	Social Sci-BA	.20			0.20	00062	21.00
2208	Sociology-BA	.70			0.70	00133	70.00

Figure 2

PROGRAM INTERACTION MATRIX EXAMPLE

Consumption Display
Academic Department and Interdisciplinary Programs
The Arts

Consuming Major - Design-BS (1009) Headcount 00222

Dept	Services Consumed	Lower Div	Upper Div	Grad Div	Total	Credit Hours
0831	Art Education	.50	.70		1.20	72.00
1009	Design	13.90	17.70		31.60	1904.00
1001	Fine Arts	8.40	7.70		16.10	969.00
1005	Music	.60	.40		1.00	64.00
1007	Speech & Th Arts	.80	.80		1.60	96.00
**********	Faculty Totals	24.20**	27.30**	0.00**	51.50**	3105.00**
2211	Afro American St	.20	.10		0.30	24.00
2202	Anthropology	1.40	.50		1.90	114.00
2209	Criminal Justice	.10	.30		0.40	24.00
2204	Economics	.20	.10		0.30	24.00
1501	English	4.90	1.90		6.80	415.00
1101	Foreign Language	1.40	1.40		2.80	171.00
2206	Geography	.80	.30		1.10	66.00
0835	Hlth, Phys. Ed, Rec	1.30	1.50		2.80	164.00
2205	History	1.40	.50		1.90	114.00
1701	Mathematics	2.10	.60		2.70	164.00
1509	Philosophy	2.10	.90		3.00	180.00
2207	Political Sci	.50	.20		0.70	48.00
2208	Sociology	2.00	.70		2.70	165.00
**********	Faculty Totals	18.40**	9.00**	0.00**	27.40**	1673.00**
0401	Biology	1.80	.50		2.30	134.00
1905	Chemistry	.30	.20		0.50	28.00
1901	General Science	1.70	.70		2.40	144.00
1999	Geosciences	1.20	.60		1.80	108.00
1902	Physics	.40	.10		0.50	36.00
2001	Psychology	2.40	.40		2.80	168.00
**********	Faculty Totals	7.80**	2.50**	0.00**	10.30**	618.00**
0822	Behavioral Stud	.10	.30		0.40	24.00
0820	Curr & Instr				0.00	0.00
0821	Foundations Educ	.10			0.10	6.00
4983	Ex Ed Gen	.10	.10		0.20	18.00
**********	Faculty Totals	0.30**	0.40**	0.00**	0.70**	51.00**

course offerings or other departmental activities. Similarly, examination of course consumption patterns can shed light not only on the interests and needs of students but also on the basic nature of the student programs. At Buffalo State, for example, some basic misconceptions about the nature of the Afro-American Studies program were removed when the Curriculum Interaction Model revealed that majors in the program drew heavily upon political science and history courses and not upon sociology and psychology courses as had been supposed. This, in turn, led to a questioning of the appropriateness of the course content offered in these areas.

In addition to being useful in its own right, the Interaction Matrix is also the basis for the second part of the Curriculum Interaction Model, the Interaction Graph.

Interaction Graph

The Interaction Graph is a curriculum interaction summary of the descending magnitude of interaction between contributing departments and consuming majors. It summarizes credit hour contributions by course level and academic division. The graphic representation of curriculum interaction overcomes the "memory problem" encountered by academic managers. The graph provides a visual summary for the curriculum interaction that takes place between contributing academic departments and consuming student programs. Figure 3 shows an example: the contribution graph for the Design Department. The graph summarizes the credit hour contribution made by the Design Department to major academic faculty and program divisions (Arts, Applied Science and Technology, etc.). These credit hour contributions are aggregated by course level as follows: "T" identifies the percentage of total Design Department credit hour production contributed to a specific group of academic programs; "L", "U",

and "G" respectively identify the corresponding percentages of lower, upper, and graduate level credit hour contribution. The actual numerical values are summarized below the graph. Thus, Figure 3 shows, for example, that 56% of the Design Department's credit hours are contributed to programs in Arts, 11.50% are contributed to lower division programs in Applied Science and Technology, etc. It should also be noted that the contribution graph shows the interaction percentages in descending order of magnitude from left to right, a detail intended to enhance visual inspection of the interaction patterns.

Figure 4 shows an example of a consumption graph. This portrays the curriculum interaction that takes place between the B.S. in Design major and the groups of academic departments by Faculty division from which it consumes credit hours. The same definitions and symbols used in the contribution graph apply to the consumption graph. Although these two examples have shown contributions to groups of programs and consumption from groups of departments, the curriculum interaction graphs apply equally to individual programs and departments.

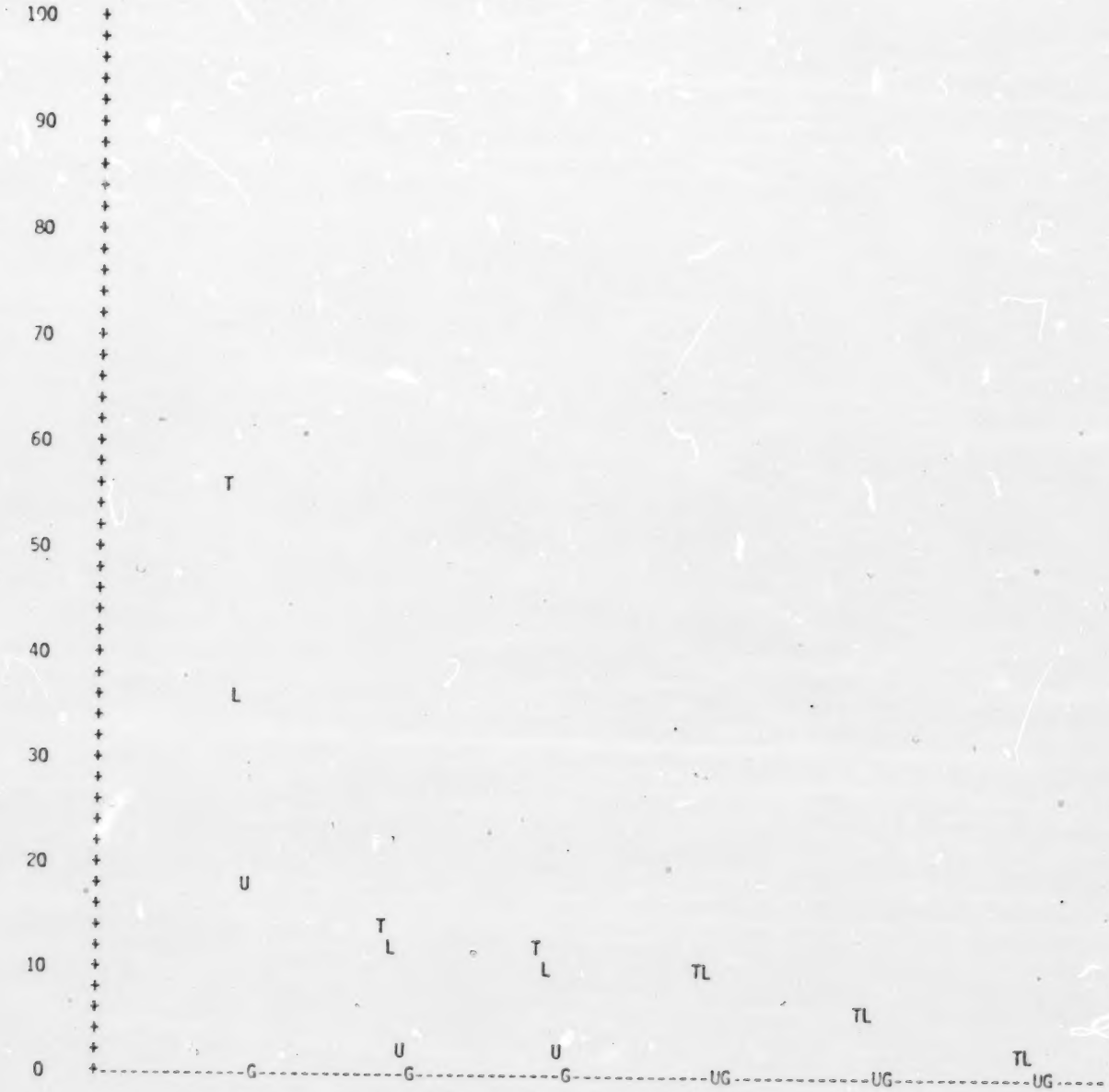
These graphic representations that are the heart of the Curriculum Interaction Model seem to overcome the "memory" and "data volume" problems encountered by department heads and deans when they attempt to discern curriculum interaction patterns. The interaction graph is in essence a menomonic device that depicts curriculum interaction information in highly aggregated and easily digestible fashion. The presence or absence of curricular interaction can be seen at a glance and extraneous information can be quickly ruled out. Once a specific area of interest is identified, the more detailed back-up information can be used as the basis for more intensive analysis. Barnard College department heads are using the graphs to locate general departmental curriculum trends between Barnard and

Figure 3

CONTRIBUTION GRAPH EXAMPLE

Contributive Display
Academic Department and Interdisciplinary Programs
The Arts

Percent of Total Department Offerings — Contributing Department - Design (1009)



SUMMARY OF CONTRIBUTED PERCENTAGES AS PER ABOVE FACULTIES

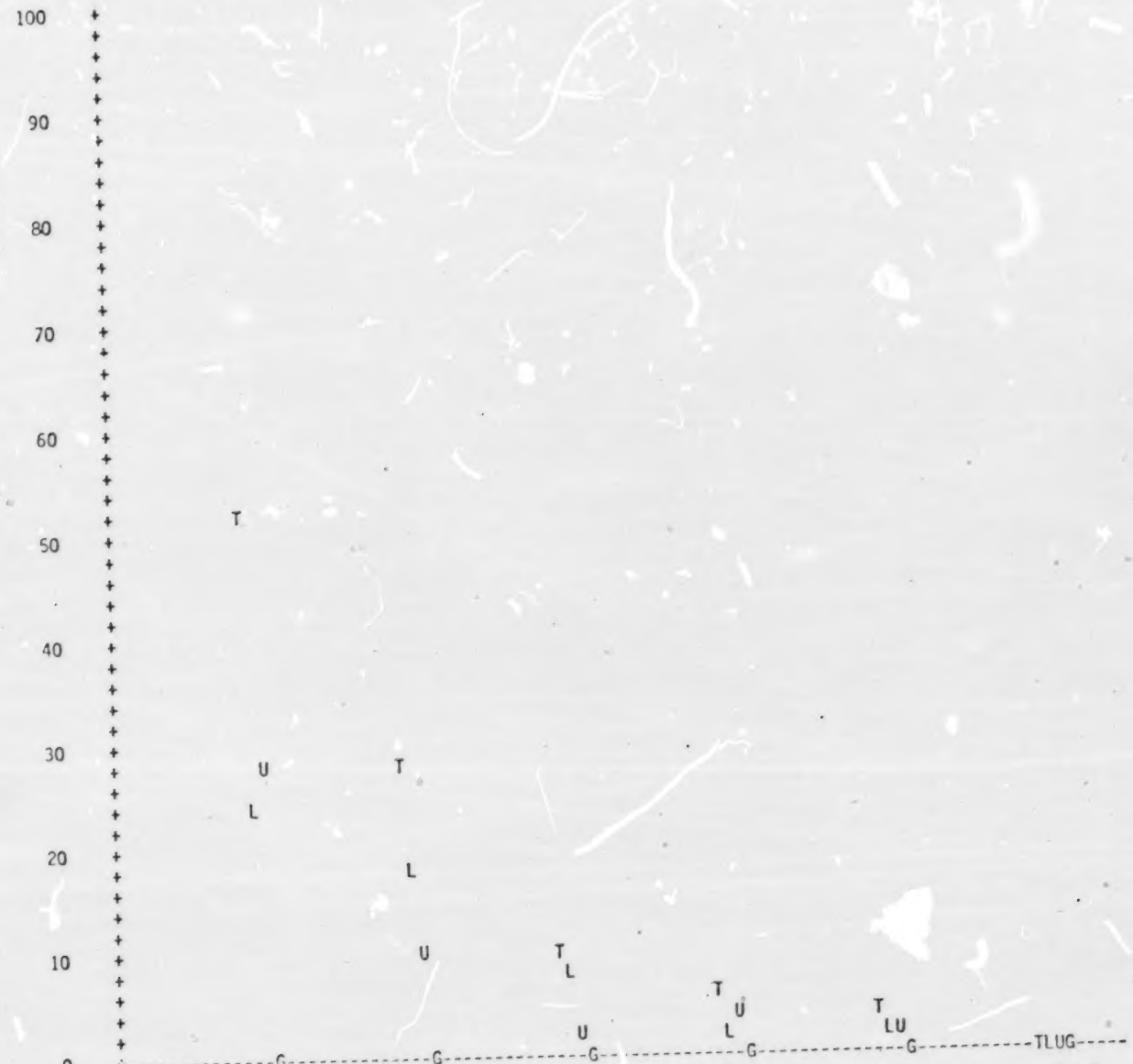
	The Arts	Appl Sci and Tech	General Studies	Prof Studies	Hum and Soc Sci	Natural Sciences
Total	56.00	13.10	11.30	10.10	6.00	2.80
Lower	36.60	11.50	9.50	9.00	5.30	2.60
Upper	17.40	1.10	1.30	0.60	0.50	0.10
Grad	2.00	0.50	0.50	0.50	0.20	0.10

Figure 4

CONSUMPTION GRAPH EXAMPLE

Consumption Display
Academic Department and Interdisciplinary Programs
The Arts

Dept Services Consumed Consuming Major - Design-BS (1009), Headcount 00222



SUMMARY OF CONSUMPTION PERCENTAGES AS PER ABOVE FACULTIES

	The Arts	Hum and Suc Sci	Natural Sciences	Appl Sci and Tech	General Studies	Prof Studies
Total	51.50	27.40	10.30	5.50	3.70	0.70
Lower	24.20	18.40	7.80	1.70	2.00	0.30
Grad	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	0.00	0.00	0.00	0.00	0.00

Columbia College. Once these trends are identified they then use the more detailed contribution-consumption matrices for specific analysis of the curriculum patterns they find interesting. Once having found "the forest," chairpersons find it easier to set about examining specific trees. An example of a complete report for the Biology Department at Buffalo State appears in the Appendix.

Interaction Trend Analysis

The Interaction Trend Analysis is a summary report designed to show a year by year trend of departmental course contribution information. The report is divided into four categories: course contribution to majors in own department; contribution to majors in other departments; contribution to undecided students (this category was termed general-liberal at Buffalo State); and total departmental contribution to the college. A fifth category was added to Barnard College's analysis, that being departmental contribution to Columbia College. Each category contains two sets of figures, the number of credit hours or units contributed and the percentage of total credit hours or units contributed.

Figure 5 shows the four-year interaction trend of eleven departments at Buffalo State. Figure 6 is an example of the Interaction Trend Analysis summary for one year at Barnard College. Barnard intends to produce an annual report in order to achieve a trend analysis summary similar to Buffalo State's. This type of analysis provides academic officers with a convenient generalized format for studying curriculum trend patterns. From this analysis, as with the Interaction Graph, they can refer back to the Interaction Matrices for detailed departmental or program information.

Figure 5

CONTRIBUTION EPORT SUMMARY* (3)
1973-74 > 1976-77

DEPARTMENT	1. No. of Cr. Hrs. Contributed 2. % of Total Cr. Hrs. Contributed												1. No. of Cr. Hrs. Contributed 2. % of All-College Cr. Hrs.			
	CONTRIBUTION TO DEPARTMENT MAJORS				CONTRIBUTION TO GNERAL LIBERAL				CONTRIBUTION TO OTHER MAJORS				TOTAL			
	1973-74	1974-75	1975-76	1976-77	1973-74	1974-75	975-76	1976-77	1973-74	1974-75	1975-76	1976-77	1973-74	1974-75	1975-76	1976-77
Art Education	3,304 55.66	3,168 52.62	3,549 56.63	3,342 53.53	522 8.79	876 14.55	601 9.59	724 11.60	2,110 35.55	1,977 32.84	2,117 33.78	2,177 34.87	5,936 2.260	6,021 2.142	6,267 2.160	6,243 2.258
Fine Arts	2,420 23.32	2,442 22.74	2,649 24.79	2,580 25.62	1,084 10.45	1,504 14.01	1,215 11.37	942 9.35	6,874 66.24	6,793 63.26	6,820 63.83	6,550 65.03	10,378 3.950	10,739 3.821	10,684 3.683	10,072 3.643
Design	1,906 20.29	1,904 19.15	2,442 24.51	3,285 31.93	740 7.88	1,145 11.52	964 9.68	821 7.98	6,747 71.83	6,893 69.33	6,557 65.81	6,182 60.09	9,393 3.575	9,942 3.537	9,963 3.434	10,288 3.721
Music	191 2.39	140 1.90	263 3.35	297 3.74	1,618 20.26	2,155 29.20	1,821 23.19	2,082 26.22	6,178 77.35	5,084 68.90	5,769 73.46	5,562 70.04	7,987 3.040	7,379 2.625	7,853 2.707	7,941 2.872
Speech & Theatre Arts	400 7.66	315 5.48	554 10.04	1,089 17.63	1,214 23.24	1,710 29.74	1,324 24.00	1,267 20.51	3,609 69 10	3,724 64.78	3,638 65.95	3,820 61.85	5,223 1.988	5,749 2.045	5,516 1.901	6,176 2.234
Biology	2,627 24.93	2,601 25.04	2,836 28.19	3,098 31.00	4,055 38.48	4,764 45.87	4,317 42.91	4,073 40.75	3,856 36.59	3,022 29.09	2,908 28.90	2,824 28.25	10,538 4.011	10,387 3.695	10,061 3.468	9,995 3.615
Chemistry	770 13.22	651 10.66	791 12.22	754 12.07	1,761 30.23	2,580 42.25	2,601 40.18	2,321 37.15	3,295 56.55	2,876 47.09	3,082 47.60	3,173 50.78	5,826 2.218	6,107 2.173	6,474 2.232	6,248 2.260
General Science	75 1.28	57 .89	108 1.62	84 1.41	1,398 23.84	2,733 42.77	2,510 37.57	2,219 37.23	4,390 74.88	3,600 56.34	4,062 60.81	3,658 61.36	5,863 2.232	6,390 2.273	6,680 2.303	5,961 2.156
Geosciences	746 26.04	645 15.21	701 15.86	838 19.39	748 26.11	1,509 35.57	1,625 36.78	1,472 34.05	1,371 47.85	2,088 49.22	2,093 47.36	2,013 46.56	2,865 1.091	4,242 1.509	4,419 1.523	4,323 1.564
Physics	276 9.83	206 8.65	259 9.21	203 8.88	623 25.95	834 35.03	999 35.54	725 31.73	1,342 64.22	1,341 56.32	1,553 55.25	1,357 59.39	2,401 0.914	2,381 0.847	2,811 0.969	2,285 0.826
Psychology	2,091 21.75	2,060 18.51	2,221 19.34	2,080 19.11	2,958 30.76	4,284 38.49	4,332 37.72	4,032 37.04	4,567 47.49	4,786 43.00	4,931 42.94	4,774 43.85	9,616 3.660	11,130 3.960	11,484 3.959	10,886 3.937

1976 - 1977

Department		Contribution to Dept. Major	Contribution to Other Majors	Contribution to Undecided	Total Barnard	Contribution to Columbia College	Grand Total
Political Science (Barnard)	1.*	161.00	91.00	204.00	456.00	96.00	552.00
	2.*	29.20	16.50	36.90	82.60	17.40	100.00
Political Science (Columbia)		108.00	107.00	42.00	257.00		
		42.00	41.60	16.40	100.00		
Psychology (Barnard)		399.00	283.50	399.00	1081.50	302.25	1383.75
		28.80	20.50	28.80	78.10	21.90	100.00
Psychology (Columbia)		87.75	83.00	36.00	206.75		
		42.40	40.10	17.50	100.00		
Sociology (Barnard)		44.00	35.00	56.00	135.00	65.00	200.00
		22.00	17.50	28.00	67.50	32.50	100.00
Sociology (Columbia)		37.00	89.00	49.00	175.00		
		21.10	50.90	28.00	100.00		
Urban Studies (Barnard)		2.00	18.00	3.00	23.00	20.00	43.00
		4.70	41.70	7.00	53.40	46.60	100.00
Urban Studies (Columbia)		--	1.00	--	1.00		
		--	100.00	--	100.00		
French (Barnard)		92.00	250.00	443.00	785.00	102.00	887.00
		10.40	28.20	49.90	88.50	11.50	100.00
French (Columbia)		5.00	67.00	44.00	116.00		
		4.30	57.80	37.90	100.00		
German (Barnard)		30.00	144.00	79.00	253.00	102.00	355.00
		8.50	40.50	22.30	71.30	28.70	100.00

* 1. Number of Units Contributed

2. Percent of Total Units Contributed

APPLICATION AND OUTCOMES

There is very little evidence to show that institutions of higher education have developed analytic mechanisms for curriculum review. The considerations presented in this paper represent only a part of the total curriculum evaluation process. But, the development of the Curriculum Interaction Model can be viewed as the critical first step in the curriculum evaluation and resource analysis process. The Model provides a basis for gaining general insights and raising levels of awareness about curriculum flows and interactions. Eventually decisions about curricular matters can rest in part upon these insights and awareness.

One of the most fundamental misconceptions about the application of quantitative and systematic approaches to curriculum evaluation is the impression that the purpose of the approach is to solve problems or to make decisions outright. The purpose of the Curriculum Interaction Model is not to tell academic managers what their decisions should be, but merely to systematically quantify, through a common set of definitions and procedures, curriculum information to assist in the planning, managing, and evaluation of resources. This quantified model must be integrated into the academic decision-making process of the institution.

The notion of curricular interaction is becoming recognized as one of the keys to understanding and managing the curriculum at Buffalo State. For example, the 1977-78 Budget Request submitted by the Dean of the Faculty of Natural Sciences made the following point:

> The Faculty of Natural Sciences recognizes its service function and role to students majoring in disciplines from other SUCB faculties. The Faculty of Natural Sciences has consistently fulfilled these responsibilities and places a high priority on excellent instruction for all students. By far the largest portion of the Faculty of Natural Sciences operating budget is expended in these efforts because approximately 75% of our credit hours are consumed by students from other than Natural Science majors.

On a more global level, the interaction data have been an explicit part of the basis for an academic reorganization at Buffalo State. The Academic Plan Committee of the Faculty Senate recommended the reorganization and observed that:

> This College currently supports five undergraduate and one graduate level deanships. Based on its hearings and substantial statistical and curricular evidence, this Committee believes that this structure could be reduced without impairing the leadership role or administrative efficiency of academic middle management...
>
> The Subcommittee has received a variety of proposals recommending changes in the Faculty structure. The CIM data strongly supports this Committee's recommendation for a three Dean set up: Arts and Humanities, Natural and Social Sciences, and Professional and Vocational or Career Programs. The first two faculty areas already show considerable curricular interrelationship. The third area would allow this institution to concentrate in new creative ways on the importance of occupational programs and their relationships to the outside community

Reorganization at the individual department level has also been supported with Curriculum Interaction Model data. For example, the Social Studies Education Department and the History Department agree to merge in part because of the very heavy interaction patterns observed between their programs. The Departments of Economics and Consumer and Business Studies followed a similar path and rationale. Other departments are currently studying possibilities. General Science, Geoscience, and Physics fall in this category, for example.

It is becoming more and more a fact of life that both colleges have fewer degrees of freedom with respect to financial resources and that academic choices must be made within cost and resource constraints. Now that curriculum interaction data are available in a usable form, they are being relied upon more and more to inform both academic and financial officers and the process and decisions associated with budget reductions are now being impacted by curricular arguments. Patterns of high and low

interaction as well as high and low cost are examined simultaneously in order to provide a broader base for academic decisions. At Barnard work is currently underway to identify more clearly the variables which influence the cost of departments and programs as well as the variables that influence curriculum interaction patterns. The more that is known about these factors, the sounder and more defensible will be the base upon which curriculum decisions rest. Barnard's Vice President for Academic Affairs sees the Curriculum Interaction Model as a major building block in the data bank which supports analysis of program and personnel economies and cost effectiveness.

Given the assumption that the curriculum is the core of the academic organization, the concepts contained in the Interaction Model can be used as a paradigm for interpreting a multiplicity of organizational management variables. By introducing the Curriculum Interaction Model to vice presidents, deans, and chairpersons, it has been found that program variables in the areas of semester course scheduling, curriculum and program evaluation, support service and faculty allocation, and budget preparation are being carefully examined and acted upon in a uniform manner, but more importantly, in a common language throughout both institutions. The Model provides a strategy for presenting curriculum variables in a way that is understandable by academic managers as well as by a College's accounting and financial staff.

By following this strategy for curriculum analysis, both colleges are now able to provide sounder rationale for program decisions that affect (1) the quality of the institution's total educational program, (2) expressed curricular needs of its students, and (3) the professional welfare and development of the college's faculty. This third point is especially important at a time when financial resources are critically short

and when management decisions affect the lives of so many of their professional staff.

FINAL OBSERVATIONS

Although one must always be cautious about drawing general conclusions from specific cases, there are a few observations worth mentioning. First, the involvement and leadership of academic managers is crucial to successfully institutionalizing the use of quantitative data in planning and management. This is true not only because of the central role of the academic curriculum in the collegiate organization, but also because of the need to indicate clearly that financial questions and curricular questions cannot be effectively considered in isolation.

Second, the "process" effects of implementing and using something like the Curriculum Interaction Model in many ways complement and enhance the benefits of specific insights associated with the resulting data. Raising the general level of awareness and understanding of curricular interrelationships may have significant long term impacts.

Third, any steps--even apparently trivial or simple ones--that make data less threatening or formidable to academic officers are probably wise investments of time and resources. Every institution is different and so the specific steps for implementation will probably differ widely.[1]

Finally, the fundamental need from the point of view of academic management is for an overall systematic design that permits integration

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* The computerized program for the CIM can be adapted to any curricular or academic structure. Canisius College and Alfred University are adapting the model to their academic planning process.

of academic management information. In a small way the Curriculum Interaction Model attempts to address that need by presenting a systematic design for curriculum analysis.

APPENDIX

BIOLOGY DEPARTMENT CONTRIBUTION REPORT

The interaction profile for the Biology Department at Buffalo State shows that Biology is primarily a contributor of lower level credit hours across the College's academic faculties. The Biology Department's major service function is in the contribution of lower level credit hours to undeclared or non-major students (general studies). It interacts at the upper and graduate credit-hour level only with a few undeclared major students and with other Natural Science departments. A more detailed examination of the interactive matrix shows that the Biology Department primarily contributes only upper level and graduate credit hours to its own Biology program.

C O N T R I B U T I V E D I S P L A Y
ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONTRIBUTING DEPARTMENT - BIOLOGY (0401)

Programs Contributed To	Lower Division	Upper Division	Graduate Division	Total	Headcount	Credit Hours
1001 Art-BA	1.00	.10		1.10	00171	111.00
0831 Art Education-BS	2.90	.10	.20	3.20	00671	336.00
1003 Art History-BA				0.00	00013	4.00
1009 Design-BS	1.20	.10		1.30	00222	134.00
1005 Music-BA				0.00	00019	3.00
1095 Theater-BA	.20			0.20	00018	21.00
1097 Undeclared-BFA	.70	.10		0.80	00073	81.00
**********Faculty Totals	6.00**	0.40**	0.20**	6.00**		690.00**
2202 Anthropology-BA	.20			0.20	00029	21.00
0605 Communication Media	.70	.10		0.80	00183	76.00
2209 Criminal Justice-BA	1.30	.20		1.50	00554	156.00
2204 Economics-BA	.40			0.40	00113	42.00
1501 English-BA	.20			0.20	00135	25.00
0882 English Sec Ed-BS	.20			0.20	00206	19.00
1102 French-BA				0.00	00008	3.00

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ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONTRIBUTING DEPARTMENT - BIOLOGY (0401)

Programs Contributed To	Lower Division	Upper Division	Graduate Division	Total	Headcount	Credit Hours
0883 French Sec Ed-BS				0.00	00025	3.00
2206 Geography-BA		.20		0.20	00016	22.00
2205 History-BA	.50			0.50	00122	48.00
4903 Humanities-BA	.10			0.10	00015	11.00
1799 Mathematics-BA	.20			0.20	00039	21.00
1701 Mathematics-BS	.10			0.10	00011	11.00
0833 Math Sec Ed-BS	.20			0.20	00124	23.00
1509 Philosophy-BA	.10			0.10	00020	11.00
2207 Political Sci-BA	.30			0.30	00093	30.00
0881 Sec Soc St-BS	.10			0.10	00168	10.00
4999 Social Sci-BA	.20			0.20	00062	25.00
2208 Sociology-BA	.30	.10		0.40	00133	36.00
2214 Urban Studies				0.00	00015	8.00
**********Faculty Totals	5.10**	0.60**	0.00**	5.70**		601.00**
0401 Biology-BA	9.90	7.70	2.30	19.90	00214	2075.00
0860 Biology Sec Ed-BS	2.10	1.30	1.70	5.10	00082	526.00

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ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONTRIBUTING DEPARTMENT - BIOLOGY (0401)

Programs Contributed To	Lower Division	Upper Division	Graduate Division	Total	Headcount	Credit Hours
1905 Chemistry-BA	1.40	.30		1.70	00060	171.00
0861 Chemistry Sec-BS	.30			0.30	00016	32.00
0862 Earth Sci Sec-BS	.50		.20	0.70	00051	69.00
0864 Gen Sci Sec Ed-BS				0.00	00021	3.00
1999 Geoscience-BA	.30			0.30	00024	34.00
1902 Physics-BA	.10			0.10	00007	9.00
1998 Physics-BS	.10			0.10	00008	7.00
2001 Psychology-BA	.80	.10		0.90	00212	93.00
**********Faculty Totals	15.50**	9.40**	4.20**	29.10**		3019.00**
0815 Comm Disord-BSED	.30			0.30	00223	37.00
0802 Elem Ed-BSED	2.00	.20	.20	2.40	01956	254.00
0818 Lrn Beh Dis-BSED	.10			0.10	00246	19.00
0810 Mtl Retard-BSED	1.20	.10		1.30	00625	139.00
0819 Phy Handicap--BSED	.10			0.10	00101	14.00
0826 St Personnel-MS				0.00	00081	3.00
**********Faculty Totals	3.70**	0.30**	0.20**	4.20**		466.00**

C O N T R I B U T I V E D I S P L A Y
ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONTRIBUTING DEPARTMENT - BIOLOGY (0401)

Programs Contributed To	Lower Division	Upper Division	Graduate Division	Total	Headcount	Credit Hours
0501 Consum Bus St-BS	.50	.10		0.60	00247	62.00
1306 Dietetics-BS	2.20			2.20	00099	227.00
0838 Dist Bus Ed-BSED	.10			0.10	00048	12.00
0909 Engineer Tech-BS				0.00	00150	3.00
1301 Home Econ-BS				0.00	00002	3.00
0899 Home Ec Ed-BSED	1.30		.10	1.40	00244	144.00
2101 HDFCR-BS	.60	.10		0.70	00296	66.00
0839 Ind Arts Ed-BSED	1.90			1.90	00616	198.00
0701 Inf Systems Man				0.00	00012	3.00
0424 Nutrin Fd Sci-BS	.90			0.90	00058	96.00
0898 Voc Tech Ed-BSED	.20	.10		0.30	00404	33.00
**********Faculty Totals	7.70**	0.30**	0.10**	8.10**		847.00**
0807 Continuing Ed	2.40	.50		2.90	00912	301.00
4952 Gen Grad Student				0.00	00043	3.00
4951 Non-Matric Grads	.10		.70	0.80	00750	86.00
4953 Post Masters			.10	0.10	00297	15.00

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ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONTRIBUTING DEPARTMENT - BIOLOGY (0401)

Programs Contributed To	Lower Division	Upper Division	Graduate Division	Total	Headcount	Credit Hours
4950 Cross Register	.40	.10		0.50	00189	51.00
4901 General Studies	40.50	.50		41.00	02616	4266.00
0813 SEEK Program	.40			0.40	00047	42.00
**********Faculty Total	43.80**	1.10**	0.80**	45.70**		4764.00**

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ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONTRIBUTING DEPARTMENT - BIOLOGY (0401)

MAJORS IN WHICH DEPARTMENTS OFFER COURSES (BY FACULTY)

	General Studies	Natural Sciences	Appl Sci and Tech	The Arts	Hum and Soc Sci	Prof Studies
TOTAL	45.70	29.10	8.10	6.60	5.70	4.20
LOWER	43.80	15.50	7.70	6.00	5.10	3.70
UPPER	1.10	9.40	0.30	0.40	0.60	0.30
GRAD	0.80	4.20	0.10	0.20	0.00	0.20

BIOLOGY DEPARTMENT CONSUMPTION REPORT

C O N S U M P T I O N D I S P L A Y
ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONSUMING MAJOR - BIOLOGY-BA (0401) Headcount 00214

Department Services Consumed	Lower Division	Upper Division	Graduate Division	Total	Credit Hours
0831 Art Education	.20	.40		0.60	36.00
1009 Design	.20	1.30	.20	1.70	98.00
1001 Fine Arts	.30	1.30	.10	1.70	94.00
1005 Music	.90	2.00		2.90	158.00
1007 Speech & Th Arts	.30	.70		1.00	57.00
**********Faculty Totals	1.90**	5.70**	0.30**	7.90**	443.00**
2211 Afro American St	.20	.60		0.80	45.00
2202 Anthropology	.80	.90		1.70	93.00
2209 Criminal Justice	.20	.50		0.70	36.00
2204 Economics	.50	.50		1.00	60.00
1501 English	1.40	1.60	.10	3.10	171.00
1101 Foreign Language	1.60	2.90		4.50	255.00
2206 Geography	.40	.40		0.80	48.00
0835 Hlth, Phys Ed, Rec	.70	2.70		3.40	192.00
2205 History	.50	.80		1.30	72.00
1701 Mathematics	1.60	1.90	.10	3.60	204.00

C O N S U M P T I O N D I S P L A Y
ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONSUMING MAJOR - BIOLOGY-BA (0401) HEADCOUNT 00214

Department Services Consumed	Lower Division	Upper Division	Graduate Division	Total	Credit Hours
1509 Philosophy	.90	.70		1.60	90.00
2207 Political Sci	.30	.30		0.60	33.00
2208 Sociology	.70	.60		1.30	75.00
**********Faculty Totals	9.80**	14.40**	0.20**	24.40**	1374.00**
0401 Biology	8.10	24.30	4.40	36.80	2075.00
1905 Chemistry	4.70	7.80	.30	12.80	723.00
1901 General Science	.60	1.20		1.80	102.00
1999 Geosciences	.50	1.50		2.00	114.00
1902 Physics	.90	3.70		4.60	258.00
2001 Psychology	1.00	1.90		2.90	162.00
4995 Environ Science	.10	.10		0.20	9.00
**********Faculty Totals	15.90**	40.50**	4.70**	61.10**	3443.00**
0822 Behavioral Stud	.70	.90		1.60	87.00
0821 Foundations Educ	.10	.40		0.50	27.00
4980 Education Gen			.10	0.10	3.00

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ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONSUMING MAJOR - BIOLOGY-BA (0401) HEADCOUNT 00214

Department Services Consumed	Lower Division	Upper Division	Graduate Division	Total	Credit Hours
4983 Ex Ed Gen	.20		.10	0.30	19.00
**********Faculty Totals	1.00**	1.30**	0.20**	2.50**	136.00**
0896 Commun & Power	.10	.20		0.30	12.00
0701 Computer Science	.30	.60		0.90	51.00
0501 Cons & Bus Stud	.10	.20		0.30	19.00
0899 Home Econ Ed			.10	0.10	4.00
1305 HDFCR	.10	.70		0.80	45.00
0893 Manufact & Const	.10	.10		0.20	6.00
0424 Nutrit Food Sci	.40	.50		0.90	48.00
0892 Prof & Rel Serv	.10	.20		0.30	12.00
0836 Safety Studies	.10	.10		0.20	6.00
**********Facutly Totals	1.30**	2.60**	0.10**	4.00**	203.00**
4999 Interdepartmental	.40	.20		0.60	33.00
**********Faculty Totals	0.40**	0.20**	0.00**	0.60**	33.00**

C O N S U M P T I O N D I S P L A Y
ACADEMIC DEPARTMENT AND INTERDISCIPLINARY PROGRAMS
NATURAL SCIENCES

CONSUMING MAJOR - BIOLOGY-BA (0401) HEADCOUNT 00214

Department Services Consumed

DEPARTMENTS TO WHICH MAJORS OFFER COURSES (BY FACULTY)

	Natural Sciences	Hum and Soc Sci	The Arts	Appl Sci and Tech	Prof Studies	General Studies
TOTAL	61.10	24.40	7.90	4.00	2.50	0.60
Lower	15.90	9.80	1.90	1.30	1.00	0.40
Upper	40.50	14.40	5.70	2.60	1.30	0.20
Grad	4.70	0.20	0.30	0.10	0.20	0.00

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